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2,4-dichlorophenoxy acetic acid-induced ear deformity in wheat (*Triticum aestivum*) in relation to its time of planting

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Spike malformation occurs in some wheat (*Triticum aestivum* L. emend. Fiori & Paol.) varieties with 2, 4-D, particularly with early stage of application, i.e. 3 or 4 weeks after sowing (Malik *et al.*, 1984; Yaduraju and Ahuja, 1992). Late application (5 or 6 weeks after sowing) is suggested to overcome this problem. In view of this, a field experiment to study the interactive effect of 2, 4-D timings and various sowing dates in wheat was carried out on sandy-loam soil during the winter season of 1991–92 at New Delhi.

The treatments included 3 planting dates (22 November, 8 December and 22 December) in main plots and 4 weed-control treatments in subplots in split-plot design with 3 replications. The subplot treatments were 2, 4-D @ 0.6 kg ai/ha applied at 4, 5 or 6 weeks after sowing and the untreated control. 'HD 2285' wheat was raised following recommended package of practices. 2, 4-D (58% ethylamine salt) was dissolved in water and applied at a volume rate of 500 litres/ha. At each application 20 wheat plants from untreated plots were uprooted and the number of leaves, tillers/plant and pseudostem height (height from ground tc the base of the last fully opened leaf; often referred to as leaf-sheath length) were recorded. At harvest, the ears from 1 quadrat (1 m x 1 m) were collected and classified normal and deformed. The deformed ears based on visual observations were further classified low, medium and high, depending on the extent of severity or deformity. The per cent values were subjected to arc-sin transformation before analysis of variance.

Application of 2, 4-D at all 3 times resulted in deformity compared with the control. However, total deformity did not differ among 3 timings of 2, 4-D (Table 1) application. The interaction effect between 2, 4-D timing and planting date was significant only for ears with medium and high deformity of leaves. Ears with medium deformity remained same for all planting dates when 2, 4-D was applied 4 or 5 weeks after sowing. However, a significant increase occurred with each delay in planting when 2, 4-D was applied 6 weeks after sowing.

The grain yield was the highest when wheat was planted on 22 November and it decreased with each successive delay in planting (Table 1). The yield attributes such as ear length, spikelets/ear and seeds/ear were not affected by any of the treatments (data not reported). The grain yield decreased (20%) with 2, 4-D applied 6 weeks after sowing in wheat planted on 22 December, implying that delay in application does not circumvent the herbicide toxicity in late-planted wheat.

The number of leaves and tillers/plant did not differ between 2, 4-D timings (Table 2). The pseudostem height was highest for

Table 1. Effect of 2, 4-D application on ear deformity and grain yield of wheat sown at different dates

Sowing date	Ear deformity (% of total ears*)					Grain yield (kg/ha)
	Normal	Low	Medium	High	Total	
22 November						
4 WAS	17.6	20.5	31.1	45.0	72.4	3,884
5 WAS	30.3	33.0	35.0	18.0	59.7	4,096
6 WAS	32.6	48.1	21.4	8.0	57.5	3,884
Untreated	90.0	4.0	4.0	4.0	4.0	4,025
8 December						
4 WAS	21.5	25.2	39.0	26.1	68.5	3,036
5 WAS	21.6	40.6	32.1	14.2	69.7	3,107
6 WAS	30.8	41.3	30.9	10.0	59.2	3,607
Untreated	90.0	4.0	4.0	4.0	4.0	3,672
22 December						
4 WAS	25.7	40.2	32.5	18.1	64.3	3,531
5 WAS	27.8	31.9	26.6	32.0	62.2	3,037
6 WAS	16.8	36.1	37.0	22.8	74.5	2,754
Untreated	90.0	4.0	4.0	4.0	4.0	3,460
CD (P = 0.05)						
Dates	NS	NS	NS	NS	NS	4.5
Application stage	9.7	8.2	4.5	8.7	10.2	NS
Interaction	NS	NS	7.9	15.2	NS	NS

WAS, Weeks after sowing
*Data subjected to arc-sin transformation

the 22 November planting and it decreased with delay in planting. The reduction in pseudostem height at 22 December planting compared with 22 November planting was 41, 66 and 70% when 2,4-D was applied at 4, 5 and 6 weeks after planting respectively. This implied that the critical physiological (developmental) stage of wheat with respect to 2, 4-D might be beyond 5 or 6 weeks after sowing for late planting of the crop. Yaduraju and Ahuja (1992) reported similar results for many wheat varieties. Pseudostem height has close relationship with floral development in several wheat varieties and pseudostem more than of 5 cm height shows lesser ear deformity with 2, 4-D application (Toffman, 1977). The temperature during December and January are

Table 2. Number of leaves and tillers/plant and pseudostem height of wheat plants at different ages under 3 sowing dates

Sowing date	Age (WAS)	Leaves/ plant	Tillers/ plant	Pseudostem height (cm)
22 November	4	4.1	2.0	3.7
	5	5.1	1.8	6.4
	6	6.0	2.0	13.7
8 December	4	4.0	1.6	2.9
	5	4.2	1.8	4.1
	6	5.0	2.0	6.6
22 December	4	3.0	1.0	2.2
	5	3.8	1.9	2.1
	6	5.0	3.0	4.2

Mean data of 20 plants
WAS, Weeks after sowing

quite low in this region which may severely restrict wheat growth.

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Effect of different leys on crop productivity and soil fertility

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Crop and soil productivity can be improved by inclusion of grasses and or pasture legumes in the rotation with grain sorghum [*Sorghum bicolor* (L.) Moench]. Ley farming systems not only provide tonnage forage yield but also enrich the soil health. Grain sorghum is a predominant crop of Bundelkhand region on marginal and sumarginal soils of dryland areas. Eight treatment combinations involving buffel grass (*Cenchrus ciliaris* L.), *Stylosanthes hamata* L. and grain sorghum were laid out in randomized block design with 3 replications on sandy-clay soil, having pH 7.1 and organic carbon 0.36%. The available nitrogen (166.2 kg/ha) and phosphorus (9.24 kg/ha) were low; however, available potassium (472.2 kg/ha) was high. The grass and legume were planted in rows 50 cm apart. *C. ciliaris* and *S. hamata* were sown in 1 : 1 row ratio. The fertilizers were applied @ 80 kg N + 30 kg P_2O_5/ha for sorghum, 40 kg N + 20 kg P_2O_5/ha for *C. ciliaris* and 20 kg N + 30 kg P_2O_5/ha for *S. hamata* and for mixed stand of *C. ciliaris* and *S. hamata*. The *C. ciliaris* and *S. hamata* were sown on 2 July 1990 and 30 July 1991 and sorghum on 10 July 1990, 2 August 1991. The *Cenchrus* and *Stylosanthes* were harvested on 13 October 1990 and 25 October 1991 and sorghum on 14 November 1990 and 26 November 1991. The total rainfall received during the crop period was 1,024.1 mm in 1990 and 891.7 mm in 1991.

Higher productivity of grain sorghum and *Cenchrus* or *Stylosanthes* were recorded in the first year compared with the second year, which was due to variation in amount and its distribution of rainfall. Significantly highest grain (11.8 q/ha) and stover (79.3 q/